

# Changing Landscapes: Glaciated Landscapes

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This optional theme involves the study of glaciated and formerly glaciated landscapes shaped by valley glaciers and ice sheets, bearing erosional and depositional imprints of the passage of glacier ice in a range of features.

Study will take place within a systems framework, focusing on spatial and temporal variations in the geomorphological processes that operate within glaciated landscapes and how the flows of energy and movement of materials combine to create specific landforms.

Scale in this theme is fundamentally at the local level but includes a wider region to put the local into context. Some content moves beyond the local to the global to embrace a variety of landscapes not evident in the UK, for example the study of contemporary permafrost degradation.

The impact of human activity as a factor causing change within glaciated landscape systems will also be studied.

As an outcome of studying this theme, learners will gain an understanding of specialised concepts: **causality** (landforms processes and landscapes), **equilibrium** (a condition of balance within the glacial system which, when established, perpetuates itself unless controlling conditions change markedly), **feedback** (within the glacial system), **interdependence** (the relationship between human activity and the glacial landscape system), **risk** (in the context of water supply), **systems** (especially the glacial mass balance system), and **threshold** (a factor that complicates the self-regulation of the glacial system: when crossed, it sets irreversible changes in motion).

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## Course Outline

### 1) What are glaciers?

Types of ice mass at a range of scales including cirque glaciers, valley glaciers, highland ice field, piedmont glaciers, ice sheets and sea ice

### 2) How and why do glaciers form?

- a. The glacial system including inputs, outputs, stores and transfers of energy and materials
- b. Change in the inputs to and outputs from a glacier over short and long-time scales
- c. The glacial budget including glacier mass balance and equilibrium
- d. Positive and negative feedback in the glacier system
- e. Causes of climate change through the Quaternary Ice Age including glacials, interglacials and stadial periods and thresholds for change
- f. Causes of changes in the glacier budget through historical time including the Little Ice Age
- g. Seasonal changes and their impact on the glacier budget

### 3) How has the distribution of glacial environments changed over time?

- a. Past distribution of valley glaciers and ice sheets during the Quaternary Ice Age
- b. Present day distribution of ice masses including valley glaciers and ice sheets

### 4) How do glaciers move?

- a. Differences between cold- and warm-based glaciers, their locations and rates of movement
- b. Glacier ice movement including internal deformation, basal sliding, sub-glacial bed deformation, surge conditions, compressional/extensional flow

### 5) How do glaciers change the landscape?

- a. Weathering – freeze-thaw weathering

- b. Erosion
  - i. Processes of abrasion, plucking and sub-glacial fluvial erosion
  - ii. Factors affecting glacial erosion including basal thermal regime, ice velocity, ice thickness, bedrock permeability and jointing
  - iii. Macro-scale glacial erosional landforms and landscapes both for and beyond the UK including cirques, pyramidal peaks, arêtes, glacial troughs, ribbon lakes, hanging valleys and truncated spurs;
  - iv. Meso-scale glacial landforms and landscapes both for and beyond the UK including roches moutonnées, crag and tail
  - v. Micro-scale glacial landforms including striations both for and beyond the UK
- c. Transport and deposition
  - i. Processes of glacial and fluvioglacial transport including supraglacial, englacial and sub glacial transfers and their resultant sediment characteristics (size, shape and sorting)
  - ii. Landforms and landscapes of glacial deposition including types of till (ablation, lodgement and deformation) and types of moraine (terminal, recessional, lateral, medial and push) and drumlins
  - iii. Processes of fluvioglacial transport and deposition lead to ice-contact features both for and beyond the UK including eskers, kames, kame terraces
  - iv. proglacial features including sandurs, varves, kettle holes and kettle lakes

## 6) How do glacial processes and landscapes vary:

- a. Spatially?
  - i. between highland and lowland
  - ii. between ice sheets and valley glaciers
- b. Over different time-scales?
  - i. Process and landform changes in seconds: rapid mass movement processes causing changes in glacial valley profiles
  - ii. Seasonal process and landform changes: landform changes associated with seasonal variations in fluvioglacial transport and deposition
  - iii. Process and landform and landscape changes over millennia: post glacial reworking of glacial deposits, infilling of glacial lakes and creation of misfit streams by fluvial processes

## 7) What are periglacial landscapes like?

- a. Ground ice formation and associated features, including ice lenses, ice wedge polygons, patterned ground, pingos and thermokarst landscape
- b. Frost weathering and mass movement can lead to features including nivation hollows, blockfields and scree slopes, pro-talus ramparts, solifluction terraces and head deposits
- c. Periglacial action of water and wind and associated landforms of dry valleys (water) and loess plateaux (wind)

## 8) What impacts do human activity and glacial landscapes have on each other?

- a. Impacts of glacial processes and landforms and landscapes on human activity including glacial lake outburst floods (GLOFs)
- b. Impacts of human activity on glacial processes and landforms and landscapes including extraction of sands and gravels and creation of reservoirs
- c. A case study of one management strategy to manage either the impacts of glacial processes/landforms /landscapes on human activity or human activity impacts on glacial processes/landforms/landscapes
- d. Permafrost degradation through human activity